Translation

PCT/EP2003/000367

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference F102R197PCT	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/EP2003/000367	International filing date (*day/month/year*) 15 January 2003 (15.01.2003)	Priority date (*day/month/year*) 24 January 2002 (24.01.2002)

International Patent Classification (IPC) or national classification and IPC
F02D 41/34

Applicant
FRAUNHOFER GESELLSCHAFT ZUR FÖRDERUNG DER ANGEWANDTEN FORSCHUNG E.V.

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 5 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 3 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☒ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☐ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
09 August 2003 (09.08.2003)	25 March 2004 (25.03.2004)
Name and mailing address of the IPEA/EP Facsimile No.	Authorized officer Telephone No.

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International Application No.
PCT/EP2003/000367

I. Basis of the report

1. With regard to the **elements** of the international application:*

☐ the international application as originally filed

☒ the description:

pages 1-13, as originally filed

pages _____, filed with the demand

pages _____, filed with the letter of _____

☒ the claims:

pages _____, as originally filed

pages _____, as amended (together with any statement under Article 19

pages _____, filed with the demand

pages 1-12, filed with the letter of 08 March 2004 (08.03.2004)

☒ the drawings:

pages 1/2-2/2, as originally filed

pages _____, filed with the demand

pages _____, filed with the letter of _____

☐ the sequence listing part of the description:

pages _____, as originally filed

pages _____, filed with the demand

pages _____, filed with the letter of _____

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.
These elements were available or furnished to this Authority in the following language _____ which is:

☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).

☐ the language of publication of the international application (under Rule 48.3(b)).

☐ the language of the translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

☐ contained in the international application in written form.

☐ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. ☐ The amendments have resulted in the cancellation of:

☐ the description, pages _____

☐ the claims, Nos. _____

☐ the drawings, sheets/fig _____

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).**

* *Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rule 70.16 and 70.17).*

** *Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.*

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International Application No.
PCT/EP2003/000367

III. Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

1. The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non obvious), or to be industrially applicable have not been examined in respect of:

☐ the entire international application.

☒ claims Nos. 1-12

because:

☐ the said international application, or the said claims Nos. _____ relate to the following subject matter which does not require an international preliminary examination *(specify)*:

☒ the description, claims or drawings *(indicate particular elements below)* or said claims Nos. 1-12 are so unclear that no meaningful opinion could be formed *(specify)*:

☐ the claims, or said claims Nos. _____ are so inadequately supported by the description that no meaningful opinion could be formed.

☐ no international search report has been established for said claims Nos. _____ .

2. A meaningful international preliminary examination cannot be carried out due to the failure of the nucleotide and/or amino acid sequence listing to comply with the standard provided for in Annex C of the Administrative Instructions:

☐ the written form has not been furnished or does not comply with the standard.

☐ the computer readable form has not been furnished or does not comply with the standard.

Supplemental Box
(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of: III.1

According to claim 1, the signals indicating the rotational speed of the shaft are to be averaged in order to "determine nonuniformities in a phase-rotation indicator", in a speed range in which gas and mass moments largely cancel each other out statistically.

However, this functional, vague statement provides no indication as to how this range is to be found. The necessary features cannot be derived from general technical knowledge, even if a textbook could point generally to the existence of such a range.

However, the necessary features of this range (these ranges) are not defined until claims 9, 10 and 11, as three different alternatives.

Consequently, claims 1 to 8 and 12 are unclear.

Moreover, claims (1 and) 9, 10, 11 (or 1 to 12) are also unclear since they do not specify how the averaging for "determining nonuniformities in a phase-rotation indicator" is to be used. Although claim 1 states that the signals are averaged as necessary, this average value is not used in the method as per claims 1, 9, 10 and 11.

Thus it is obvious that essential features for solving the problem of "determining nonuniformities in a phase-rotation indicator" are missing from claim(s) 1 (to 12), which prevents the method from being assessed, owing to a lack of clarity.

Supplemental Box
(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of: III.1

In addition, claim 11 states that (when there is an uneven number of cylinders) it is not even necessary to select a particular speed range, such that the features of claims 1 and 11 (insofar as it is currently comprehensible) are suggested by US-A-5 117 681.

US-A-5 117 681 discloses an error-determining and -correction system on the phase-angle sensor 10 of an internal combustion engine, for correcting speed values, a factor Ci being obtained during coastdown (figure 3) from the angle - velocity value (Vi) and the averaged angular velocity omega-i (column 5, line 24; around a segment), said factor Ci enabling the nonuniformities of the sensor wheel 10 to be determined and corrected.

This method is not restricted to a particular number of cylinders and is therefore used by a person skilled in the art for internal combustion engines having either an even or an uneven number of cylinders, such that he can arrive at the subject matter of claims 1+11 (at least) without exercising inventive skill.

CLAIMS

1. A method for determining geometric errors of a rotary encoder with a plurality of increments that can be registered by a sensor, said encoder being for an internal combustion engine and being mounted on a shaft which can be directly or indirectly set in motion by gas moments and moments of inertia,

characterised in that the profile of the angular velocity $\omega_{mess}(t)$ is measured for a time-variable shaft speed, that the shaft speed signals obtained during said measurement are averaged and that said averaging process is carried out within a shaft speed range in which the effects of the gas moments and moments of inertia, which act on the shaft in the internal combustion engine, on the angular velocity of the crankshaft cancel each other out statistically, at least to a great extent and that geometric errors of the rotary encoder are determined on the basis of the profile of the angular velocity $\omega_{mess}(t)$.

2. The method according to claim 2,

characterised in that a mean angular velocity ϖ_n per shaft rotation (n) is calculated at least approximately on the basis of the measured profile of the angular velocity $\omega_{mess}(t)$.

3. The method according to claim 2,

characterised in that an increment(z)-related angular velocity $\varpi_R(z)$ is calculated at least approximately from the mean angular velocity ω_R..

4. The method according to claim 3,

characterised in that the increment(z)-related angular velocity $\omega_n(z)$ is calculated from at least two calculated mean angular velocities ϖ_{n-1} and ϖ_{n+1}.

5. The method according to claim 3 or 4,

characterised in that the profile of the increment(z)-related angular velocity $\omega_n(n)$ is at least approximated by a polynomial.

6. The method according to claim 5,

characterised in that the increment(z)-related angular velocity $\omega_n(z)$ is obtained as a function value of the function described by the polynomial.

7. The method according to any one of claims 1 to 4,

characterised in that the averaging is a linear averaging which is carried out over the increment(z)-related angular velocities $\omega_n(z)$ per increment (z) and shaft rotation (n) on the basis of the following relationship which gives an incremental angular error per rotation as geometric error:

$$\Delta\varphi_{e_n}(z) = \frac{1}{k-l}\sum_{n=1}^{k}\left[\frac{\omega_n(z)}{f(z)} - \Delta\varphi_i(z)\right]$$

where $\Delta\varphi_{en}(z)$ incremental angular error per rotation
$\omega_n(z)$ incremental angular velocity per rotation
$f(z)$ increment frequency
$\Delta\varphi_i(z)$ angular increment for ideal increment
k, l rotation indices for lower and upper speed limit

8. The method according to any one of claims 1 to 7,

characterised in that the time-variable shaft speed is obtained as part of a coast-down, towing or compression test.

9. The method according to any one of claims 1 to 8,

characterised in that the speed range within which the effects of the gas moments and moments of inertia on the shaft speed cancel each other out statistically, at least to a great extent, is selected such that initially that surge speed is sought for which a phase shift occurs in the shaft speed signal caused by a change in dominance between gas moments and moments of inertia, and that the speed range is selected about this surge speed such that an alternating component obtained in the speed signal is as small as possible after its averaging.

10. The method according to claim 7,

characterised in that the speed range within which the effects of the gas moments and moments of inertia on the shaft speed cancel each other out statistically, at least to a great extent, is selected such that the incremental angular error $\Delta\varphi_{en}(z)$ is determined as a function of the speed and that that speed range in which the angular error is smallest is selected.

11. The method according to any one of claims 1 to 7,

characterised in that in the case of an internal combustion engine having an odd number of cylinders, an arbitrary speed range is used to measure the angular velocity when determining the geometric error.

12. The method according to any one of claims 1 to 11 characterised in that the geometric error obtained in the form of an incremental angular geometric error $\Delta\varphi_{en}(z)$ is used for correction when determining the speed of the internal combustion engine.